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DATA BASED DEVELOPMENT PLANNING: BIG DATA INNOVATION AND GEOSPATIAL INFORMATION SYSTEMS

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ABSTRACT: Data-driven development planning is an important paradigm in realizing more accurate and accountable development governance. The development of big data and Geographic Information Systems (GIS) provides a great opportunity to improve the effectiveness of planning at the national and regional levels. This study aims to analyze the integration of big data and GIS in strengthening data-driven planning in Indonesia. Using qualitative methods through literature studies, this research examines scientific literature and government policies related to digital planning innovation. The results show that the collaboration between big data and GIS can encourage more adaptive, transparent, and sustainable planning through improved analysis, demand prediction, and spatial visualization. These findings provide theoretical contributions as well as practical recommendations for strengthening technology-based development governance.
Keywords: *Data-Driven Big Data, Geospatial Information Systems, Evidence Based*

INTRODUCTION

Data-driven development planning has now evolved into a new paradigm in development governance at both the national and regional levels, where every public policy is required to be based on empirical evidence and comprehensive data analysis. Entering the digital age, the emergence of big data and advances in geospatial technology have opened up vast opportunities to improve the effectiveness and accuracy of development

policy direction. Since 2019, the Indonesian government, through the Ministry of National Development Planning/Bappenas, has launched the Satu Data Indonesia initiative to achieve data integration and interoperability between agencies. However, the implementation of this policy still faces a number of obstacles, such as uneven data quality, weak coordination between agencies, and limited human resource competencies in data analysis (Bappenas, 2022). In fact, research findings show that the application of big data analytics can increase the efficiency of development planning by up to 30% through faster and evidence-based decision-making processes (Putra & Rahmawati, 2021).

Although various studies have discussed the importance of digitization in governance, most previous studies have focused on e-government or administrative information systems, with few researching the integration of Big Data and Geospatial In

formation Systems (GIS) simultaneously in the context of development planning. This condition creates a research gap regarding how the synergy between these two technologies can strengthen the quality of regional-based planning and local community needs. (Prasetyo and Nugroho, 2023) emphasize that GIS plays an important role in describing the spatial distribution of development, but its relationship with big data analysis has been minimally explored to support more comprehensive decision-making. In line with this, (Fitriani et al., 2022) found that only about 40% of local governments have successfully integrated spatial data with sectoral data effectively, indicating that the use of data as a basis for evidence-based planning is still not optimal.

The urgency of this research is even stronger given the increasing complexity of national development, which requires a cross-sectoral and cross-regional approach. The integrated use of Big Data and GIS is believed to be a strategic instrument for reducing development inequality, strengthening policy transparency, and accelerating the achievement of the Sustainable Development Goals (SDGs). Therefore, this study aims to comprehensively examine how innovations in Big Data and GIS can improve the quality of development planning, strengthen monitoring and evaluation systems, and accelerate data-based decision-making processes. Theoretically, this study is expected to enrich the development of data-based development planning models, while in practice, the results can provide policy recommendations for the government and academics in creating adaptive and sustainable development governance. Thus, the study entitled "Data-Based Development Planning: Big Data and Geospatial Information System Innovations" is important to fill the gaps in previous research and provide a new direction for the transformation of national development planning oriented towards data and technology.

LITERATURE REVIEW

Data-Based Development Planning

Data-driven development planning is a modern paradigm in development governance that emphasizes the use of empirical data and comprehensive analysis as the basis for public decision-making. This approach shifts away from the old pattern of relying on intuition, political

considerations, or subjective assumptions, towards an evidence-based planning system and integrated data analysis (Bibri, 2021). This concept is known as data-driven planning, which is a planning method that uses big data, geospatial information systems, and digital technology to design more effective, efficient, and accountable policies (Wu, 2022).

This approach is based on Evidence-Based Policy and Planning Theory, which asserts that the formulation of quality public policy must be based on empirical data and measurable analysis (Nutley et al., 2021). The principle of evidence-based planning marks a paradigm shift from normative planning to results-based planning. This approach plays an important role in increasing transparency, policy effectiveness, and evaluative capacity in development implementation. In addition, Socio Technical Systems Theory also provides a perspective that the success of data-based planning implementation is not only determined by technological aspects, but also by the integration of human, organizational, and technological factors in building adaptive social systems (Liu & Cao, 2022).

Research findings (Bibri, 2021) show that the application of data-based planning principles in various cities contributes to increased public service efficiency, optimized environmental management, and increased accountability in the decision-making process. Through big data analysis, predictive capabilities in planning are enhanced and coordination between institutions becomes more effective. Thus, data-based development planning can be understood as the result of collaboration between technological innovation, institutional capacity, and solid political support in promoting sustainable development that is responsive to community needs.

Big Data Innovation

Big data innovation includes efforts to create, develop, and apply technologies and analytical methods capable of managing data with large volumes, high speeds, and complex variations from various information sources (Yu et al., 2023). The existence of big data is a key element in supporting the development planning process because it enables the government to analyze socio-economic patterns, predict community needs, and evaluate the impact of policies quickly and accurately (Mete, 2023). The link between big data innovation and the effectiveness of development planning is the Diffusion of Innovation Theory proposed by Everett Rogers. This theory highlights how a technological innovation is adopted by organizations based on factors of relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). In addition, the Technology Organization Environment (TOE) Framework from (Tornatzky and Fleischer, 1990) is also relevant, as it explains that the acceptance of new technologies, including big data, is influenced by technological aspects, organizational structure, and external support such as government policies and the political environment. The results of Mete's (2023) research show that the application of big data innovation can improve efficiency in the decision-making process, especially in the infrastructure and spatial planning sectors. Meanwhile, the findings of Yu et al. (2023) confirm that the use of data from

satellite imagery, social media, and environmental sensors can strengthen the accuracy of spatial analysis in urban planning. Therefore, big data innovation has been proven to make a real contribution to improving the quality and accuracy of data-based development planning.

Geospatial Information System

A Geospatial Information System (GIS) is a computer-based system that collects, stores, manages, analyzes, and displays data with a geographic dimension (Yu et al., 2023). In the context of development planning, GIS plays an important role in mapping regional potential, analyzing land use patterns, identifying disaster risks, and determining development priorities based on location and regional characteristics (Mansourihanis, 2025). Based on Spatial Planning Theory, the spatial aspect is a key element in development because all economic and social activities always occur in limited spaces that interact with each other (Cao, 2024). The application of GIS makes this theory more applicable through its spatial analysis and data visualization capabilities, thereby helping policy makers understand the geographical interrelationships between variables. In addition, Decision Support System Theory (DSS) is also relevant, because GIS functions as a decision support system that is capable of integrating various layers of data (multi-layer data) into interactive maps to support the analysis and policy-making processes (Dritsas, 2025). The results of research by Yu et al. (2023) show that GIS is effective in utilizing remote sensing data for urban planning. Meanwhile, a study conducted by Cao (2024) found that the application of GIS with a spatial optimization approach can improve the efficiency of development resource distribution and reduce inter-regional disparities. Thus, Geospatial Information Systems contribute significantly to improving the accuracy, effectiveness, and transparency of development planning processes based on data and empirical evidence.

METHODOLOGY

The data in this study was obtained through library research by reviewing various scientific sources, including national and international journals, research reports, government policy documents, and credible online sources relevant to the themes of data-based development planning, big data, and geospatial information systems. This study used a qualitative method with a descriptive approach, which aimed to gain an in-depth understanding of the process of integrating big data innovation and geospatial information systems into development planning at the national and regional levels. The type of research used was exploratory qualitative, as it focused on understanding concepts and applications without directly intervening in the object of study. Data analysis was conducted using Miles and Huberman's interactive model, which includes three main stages: data reduction, data presentation, and inductive conclusion drawing to find patterns, relationships, and meanings contained in the data. To maintain data validity and reliability, source triangulation was performed by comparing various literature and official documents, resulting in objective and accountable analysis results. This approach allows researchers to explore the relationship between data technology innovation and the effectiveness of evidence-based development policies (Sugiyono, 2022).

RESULT

The research findings show that Data-Based Development Planning: Big Data Innovation and Geospatial Information Systems reflect a paradigm shift from conventional planning to an approach based on evidence and comprehensive data analysis. Based on the Evidence-Based Policy and Planning Theory framework (Nutley et al., 2021), the results of the analysis confirm that development decision-making based on empirical data produces more measurable, adaptive, and accountable policies. The implementation of this approach in various regions has shown an increase in effectiveness in determining development priorities, optimizing public budgets, and monitoring policy outcomes on an ongoing basis. For example, in infrastructure planning, the use of spatial and socioeconomic data helps the government determine the locations most in need of intervention, rather than based solely on political considerations. This is in line with the view (Bibri, 2021) that data-driven planning strengthens public accountability because decisions are based on verifiable evidence. Thus, the results of the study show that integrating data analysis into public planning systems reduces the gap between planning and implementation of development policies.

In the context of big data innovation, the results of the discussion show that the use of large data with the characteristics of volume, velocity, and variety plays an important role in promoting the effectiveness of development planning. Referring to the Diffusion of Innovation Theory (Rogers, 2003), big data is understood not only as a technological tool but also as a social innovation that changes the way governments collect, manage, and interpret public data. Studies by Mete (2023) and Yu et al. (2023) show that the use of big data enables predictive analysis of socio-economic behavior, including population mobility patterns, energy use, and environmental changes. Specifically, the application of big data in smart city systems can improve the efficiency of public services and accelerate policy responses to community needs. These results are also in line with the Technology Organization Environment Framework (Tornatzky & Fleischer, 1990), which emphasizes that the successful adoption of new technologies is influenced by institutional readiness, digital infrastructure support, and policies that support data openness. Thus, big data innovation serves as the foundation for more rational, rapid, and results-oriented decision-making in modern development systems.

DISCUSSION

The application of Geospatial Information Systems (GIS) has been proven to strengthen the spatial dimension in the development planning process. Based on Spatial Planning Theory (Cao, 2024), every development policy must consider spatial and regional aspects because economic and social activities always interact within a specific geographical context. Research results show that the use of GIS helps the government map regional potential, analyze development gaps, and identify disaster-prone areas with a high degree of accuracy. For example, by combining topography, population, and

infrastructure data, the government can determine the ideal location for the construction of public facilities such as hospitals or schools. Research by Yu et al. (2023) and Dritsas (2025) proves that GIS integrated into a Decision Support System (DSS) is capable of transforming complex data into easily understandable spatial information in the form of interactive maps. This strengthens the effectiveness and transparency of location-based decision making, which is at the core of data-driven development planning.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that Data-Based Development Planning: Big Data Innovation and Geospatial Information Systems mark a significant shift in development planning practices towards a more evidence-based, transparent, and sustainability-oriented system. The use of big data provides broader and more predictive analytical capabilities, thereby supporting fast, accurate, and measurable decision-making. On the other hand, the application of Geospatial Information Systems (GIS) enriches the planning process with a spatial dimension that enables more accurate mapping of regional potential, analysis of development inequalities, and determination of priority areas. The collaboration between big data and GIS has given rise to a geo-analytical planning approach that increases the effectiveness of public policy while strengthening accountability and efficiency in the management of development resources. Thus, data-based development planning is not merely the application of technology, but a conceptual transformation towards adaptive, inclusive, and responsive governance in the digital era.

RECOMMENDATIONS

Based on the results of the study, it is recommended that the government strengthen the implementation of data-based development planning by improving the quality and integration of data between agencies, as well as developing human resource competencies in the fields of big data and geospatial information systems. For academics and students, this study is expected to serve as a reference in developing data-based studies and innovations to support more effective, transparent, and sustainable development policies.

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